Intuitive Judgment and Strategic Decisions

A Monograph

by

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14. ABSTRACT

How can senior military leaders (field and flag grade officers) use current research on intuitive judgment to improve the quality of their decisions? Dr. Gary Klein's Naturalistic Decision Making has heavily influenced military decision making. Drs. Daniel Kahneman (recipient of the 2002 Nobel Memorial Prize in Economics) and Amos Tversky pioneered heuristics and biases research. Their research and those they influenced have different views on the value of intuitive judgment. Assessing these differences reveals techniques that can improve the decision making.

Senior military leaders make decisions in an environment that is time constrained, unknowable, and has innumerable outcomes. The research supporting this monograph is immediately relevant to decision making in the military. Identified within, are ten ways recent heuristics and biases research can be incorporated into the thought habits of senior military leaders to improve the quality of intuitive judgments made by senior military leaders making strategic decisions.

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Abstract

Intuitive Judgment and Strategic Decisions by LtCol Jacob Q. Robinson, US Marine Corps, 44 pages.

How can senior military leaders (field and flag grade officers) use current research on intuitive judgment to improve the quality of their decisions?

Intuitive judgment is critical to decision making. Dr. Gary Klein's Naturalistic Decision Making has heavily influenced military decision making training and doctrine. The research on heuristics and biases assesses the value of intuitive judgment different than Dr. Klein and indicates it is less effective when applied to the novel problems faced by today's senior military leaders. Dr. Daniel Kahneman (recipient of the 2002 Nobel Memorial Prize in Economic Sciences) and his research partner Dr. Amos Tversky pioneered research on heuristics and biases. Kahneman and Tversky's findings on intuitive judgments and the related findings of the many heuristics and biases researchers they influenced can be incorporated into the decision making habits of senior military leaders.

The end goal for every military leader is to improve the quality of decisions. For senior military leaders (field and flag grade officers), decisions are and will continue to be made in an environment that is time constrained, unknowable, and has too many possible outcomes to consider them individually. The research supporting this monograph is immediately relevant to the decision making of senior military officers and ten recommendations that can be incorporated into decision making processes are identified.

Contents

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Introduction

Human decision making is a deep field of study with its roots dating back to ancient stories of creation such as: Adam and Eve from the Bible, Tokahe of the Lakota Emergence Story, and the ancient Greek myth of Pandora's box. Most interesting about these stories and those like them is that they are based on bad decisions, or at best, decisions that made an existing situation worse. It can be said that human decision making research is based on the fear of making a bad decision. It is in this light that this monograph seeks to identify ways to improve intuitive judgement and the quality of decisions, specifically those made by military leaders.

The human ability to make decisions, think critically and apply judgment when solving problems are well-studied topics that play an important role in decision making research. Numerous academic disciplines contribute to decision making research. A few examples include: philosophy, logic, psychology, economics, culture, critical thinking, decision making, and the study of complexity.

Decision making is a particularly important topic for senior military leaders. It is important to emphasize that the focus of this monograph is on the decisions required by senior military officers about military problems or military related policy during wartime. This environment is not often studied by the social scientists who have done the majority of the research. Extrapolating and borrowing from social science research and applying it to this environment, in some cases, requires an estimation based military experience and may need to be further studied within the specific constraints and limitations of the environment where military leaders make decisions. In this monograph, although not all-inclusive, military leaders is defined by field and flag grade officers.

It is routinely necessary for these leaders to make decisions about unfamiliar problems when information is incomplete, unavailable, and often overwhelming. Adding to this stress, the decisions involve tens to hundreds-of-millions of dollars' worth of equipment or property. More

importantly, decisions often have life or death consequences. Correspondingly, a goal of every military professional should be to improve the quality of their judgments and make better decisions. Making better decisions by improving accuracy becomes an even greater imperative as one becomes more senior and the decisions become larger in scope and involve more unknown and unknowable variables.

Marine Corps Doctrinal Publication (MCDP) 6, Command and Control (C2), notes analytical and intuitive as the two types of decision making. It favors the intuitive approach because war is an art rather than science and intuitive decision making arrives at an acceptable solution to a problem where analytical decision making arrives at an optimal solution.[1] Referencing the naturalistic decision making research by Dr. Gary A. Klein, it also notes that intuitive decision making is "more appropriate for the vast majority of typical or operational decisions."[2]

The idea of intuitive judgment in decision making heavily influences military doctrine and education. This type of recognition may be less effective when applied to the problems faced by today's military leaders. There is a significant amount of research on intuitive decision making, done in the past ten years, that is applicable to military decision making. This research needs to be incorporated into the habits of thought of military officers to increase the quality of their intuitive judgments applied to strategic decisions.

Decision making is a common topic in the US Army's School of Advanced Military Studies (SAMS) monographs and US Army research papers. Notably the US Army White Paper by the Human Dimension Capabilities Development Task Force, Capabilities Development Integration Directorate, Mission Command Center of Excellence, titled "*Cognitive Biases and Decision Making: A Literature Review and discussion of Implication for the US Army*" addresses

[1] US Marine Corps, Marine Corps Doctrinal Publication (MCDP) 6, *Command and Control*, (Washington, DC: Government Printing Office, 2018), 102.

[2] US Marine Corps, MCDP 6, 103.

the newer idea of decision making and biases, but offers areas for additional research rather than tangible methods to improve decision making.

Professional military leaders responsible for strategic decisions will benefit from a detailed understanding of the process by which they make decisions when solving problems and developing advice when the situation is novel and unfamiliar. Much of the existing military doctrine does not effectively incorporate ideas from heuristics and biases and the numerous related research studies regarding intuitive decision making. Analyzing this research and identifying useful techniques to improve decisions will increase the quality of the best military advice provided to civilian leaders regarding strategic problems.

This monograph focused on this question: How can current research on intuitive judgments made during decision making be used by military leaders to improve the quality of their decisions? Many existing decision making techniques remain useful, but there is a great deal of research that can be incorporated into the habits of thought and training of military leaders now or has significant potential and warrants immediate further research. The end goal is to identify tangible actions that will improve the quality of decisions in an environment that is time constrained, unknowable, and has too many possible outcomes to consider. This is and will continue to be the environment where the most challenging decisions with the greatest strategic implications will be made.

This monograph examines intuitive decision making by assessing naturalistic, and heuristics and biases decision making research, System 1 and 2 thinking, and the most recent literature on decision making. Understanding the influence Klein's naturalistic decision making research has on current military training and education methods establishes the basis for thinking about the relevance of newer research. The newer research explores heuristics and biases decision making, a different way to think about and view the subject, made popular by Dr. Daniel Kahneman with his 2011 book *Thinking, Fast and Slow*. Kahneman is also a recipient of the 2002 Nobel Memorial Prize in Economic Sciences and his idea of System 1

(intuitive/automatic/recognition) and 2 (analytical/effortful/complex) thinking, which adds to the understanding of military decision making and provides a different way to look at decision making. After establishing an understanding of the two most prominent views on intuitive decision making, more recent research on decision making will be assessed. Finally, the monograph identifies lessons relevant to strategic leaders and concludes the ten most important considerations that will improve the quality of field-grade, military officer's intuitive decision making.

This monograph has several assumptions and limitations. The preponderance of the research on decision making is done by social scientists. It is their research and the author's experience in the US Military on which this monograph is based. The approach used during this monograph is to analyze research and theory from the related social science disciplines and assess its applicability to military decision makers. The underlying assumption is that decisions faced in the future will continue to be about challenging problems involving poor and conflicting information that requires balancing military objectives with realities of politics. A complete understanding of decision making requires study of critical thinking, cognition, and logic. These are separate and well-studied topics with important considerations for how humans make decisions, but are outside the scope of this monograph. The goal of all decision making research is to improve the quality of the decision or to give the decision maker the tools to come up with a better outcome. The human mind is the variable, which is still not completely understood, and the challenge of all decision making research is to assess and improve intuitive decisions.

The assumption of who is a military decision maker in this monograph is a field-grade officer, major/lieutenant commander through colonel/captain. These are officers responsible for making decisions that have strategic implications or working as part of a staff that develops recommendations for more senior military or civilian leaders making decision with policy and/or strategic implications. For the purposes of this monograph, the Joint Publication 3-0, Operations definition of strategy is assumed: "A prudent set of ideas for employing the instruments of

national power in a synchronized and integrated fashion to achieve theater, national, and/or multinational objectives."

This monograph will add to the body of work by focusing on intuitive judgments and naturalistic and heuristics and biases decision making research. Additionally, the monograph will address the focus of the US military on intuitive decision making and assess how the range of interpretations are relevant to the strategic problems faced by senior leaders. Understanding the idea of rational behavior, cognitive bias, and recent thoughts on decision making research reveals methods and ideas today's leaders can incorporate into their thought processes to improve intuitive decision making.

Literature Review

Decisions have consequences and this idea dates to ancient times and much has been written on the subject. Decision making is a focus area of research in the fields of psychology, economics, neuroscience, and the military to name a few. The term decision making is commonly substituted with problem solving in European research. There was no clear distinction in periods of decision making research until in 1989 Klein coined the term naturalistic decision making, which defined the field of research. Kahneman's work has made the term heuristics and biases part of the decision making lexicon. There are numerous authors outside these two defined research methods whose literature helps frame the discussion of decision making.

Two early works put forward ideas that were fundamentally different than what was believed at the time and they still have significant influence on current research. Paul Meehl was an accomplished psychologist who also taught in law, psychiatry, neurology, and philosophy departments during his time at the University of Minnesota. In 1954 he published a paper titled "Clinical versus statistical prediction: A theoretical analysis and a review of the evidence." Kahneman refers to Meehl as one of his heroes and noted that he was significantly influenced by this work. Contrary to the long-held belief that humans could make the best decisions, this study

demonstrated that algorithms were more accurate than clinical predictions. This finding has been replicated in more than two hundred studies since.[3] This idea has significantly contributed to the study of decision making

The second influential work is Herbert Simon's *Administrative Behavior: A study of Decision-Making Processes in Administrative Organizations*, which was first published in 1947 and consistently updated until his death in 2001. The two significant contributions of *Administrative Behavior* are: the influence it has had on business decision making and its introduction of bounded rationality and introducing the term satisficing. Satisficing described the outcome of decisions as seeking an acceptable solution, instead of the long-held belief on which economics was based, that decisions sought to make an idealistic solution that maximized the utility of the decision.

The work of Janis and Mann (1977) demonstrated that people avoid making decisions because of the stress of carrying out the analysis. They offered the following ideas for making better decisions: thoroughly canvas a wide range of options; survey a full range of objectives; carefully with the costs, risks, and benefits of each option; intensively search for new information in evaluating options; assimilate all new information; reexamine the positive and negative consequences of each option; and carefully plan to include contingencies if various risks occur.[4] Simon's views on rationality is not widely reflected in research until much later and this work by Janis and Mann's work reflects the idea of rational choice in decision making, which was still the prevailing idea at the time.

Henry Mintzburg, in his 1994 book *The Rise and Fall of Strategic Planning*, offers insight on decision making research. As the name suggests the book is about strategic planning, but woven into the discussion on planning and strategy is a perspective that summarizes the

[3] Daniel Kahneman, *Thinking, Fast and Slow* (New York: Farrar, Straus, and Giroux, 2011), 222.

[4] Gary A. Klein, *Sources of Power: How People Make Decisions* (Cambridge: The Massachusetts Institute of Technology Press, 1999), 3.

modern study of decision making. Two of the five definitions for planning are linked to decision making: planning is decision making and planning is integrated decision making.[5] Mintzburg notes that going back to 1949, business research has linked planning to decision making and thus makes an estimation about the future. Ultimately Mintzburg notes that planning should not be considered strategy or decision making.[6] The importance of this assessment is that much of the research on decision making up to the time was focused on processes, like planning and management styles, and not specifically on the intuitive aspects of decision making.

Simon began to change the way decisions were viewed and Mintzburg moved from processes to the cognitive aspects of decision making, which led to the idea of intuition in naturalistic decision making and heuristics and biases decision making research. This is an incomplete assessment of all decision making research up to naturalistic decision making, but these works are highlighted because they still continue to influence current research. The following will focus on naturalistic decision making and heuristics and biases.

Cognition and critical thinking have been studied extensively throughout the years. In the landmark 1982 study, *Judgment Under Uncertainty: Heuristics and Biases*, published by Kahneman, Tversky, and Dr. Paul Slovic, they identified three fundamental heuristics: representativeness, anchoring and adjustment and availability. From these comes the idea of cognitive biases. Dr. Max H. Bazerman applied these three heuristics and the idea of cognitive bias to business literature. His *Judgment in Managerial Decision Making* provides an overview of intuitive decision making relevant to business. He writes "judgment refers to the cognitive aspects of the decision-making process," which is a particularly useful idea for framing the discussion for military leaders.[7] Additionally, he uses the idea of system 1 and 2 thinking and the three broad

[5] Henry Mintzburg, *The Rise and Fall of Strategic Planning Reconceiving Roles for Planning, Plans, Planners* (New York: The Free Press, 1994), 9-11.

[6] Henry Mintzburg, *The Rise and Fall of Strategic Planning,* 15.

[7] Max H. Bazerman, *Judgment in Managerial Decision Making* (New York: Wiley, 2012), 2.

categories of cognitive bias derived from Kahneman and Dr. Amos Tversky's work. Bazerman focuses on three general judgmental heuristics and from these he identifies thirteen common biases.

The study of military decision making often involves historical perspective and addresses the quality and effectiveness of the decisions based on the outcome. The study of business decision making often focuses on cognition and how to make better decisions. Much of the work done on analyzing military decisions and the basis of current military doctrine assumes that intuition and learned skills are the most important factors leading to effective decisions that achieve the desired outcome. The naturalistic decision making research approach has heavily influenced the study of both business and military decision making.

Klein pioneered naturalistic decision making and he continues to write and research extensively on the topic. The field of naturalistic decision making seeks to define how people make decisions and improve the outcomes. It does this by studying decisions in the "real world", vice in a laboratory under controlled conditions and a brief definition of naturalistic decision making is "NDM is the way people use their experience to make decision in field settings."[8] In 1989, the first in a still on-going series of conferences, now titled the International Naturalistic Decision Making Conference was held.[9] Naturalistic decision making began influencing the US military in the mid-1980s. Its influence notably increased when US Navy became interested in 1988 after the tragic shootdown of Iran Air Flight 655 by the USS *Vincennes*.[10]

Klein's naturalistic decision making work has influenced the thinkers and doctrine writers of the US Army and United States Marine Corps (USMC) in many ways. In the mid-

[8] Caroline E. Zsambok, "Naturalistic Decision Making: Where Are We Now?" In *Naturalistic Decision* Making, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 4.

[9] Jan Maarten Schraagen, "Naturalistic Decision Making." *The Routledge International Handbook of Thinking and Reasoning* (New York, NY: Routledge/Taylor & Francis Group, 2018), 487-504.

[10] Gary Klein, "Naturalistic Decision Making," *Human Factors: The Journal of the Human Factors and Ergonomics Society* 50, no. 3 (June 2008): 456-460.

1980s, the Army Research Institute for the Behavioral and Social Sciences began funding naturalistic decision making research. Since then, numerous US Army academic and doctrinal documents including Command and General Staff and the School of Advanced Military Studies monographs, Mission Command Center of Excellence White papers, and the most recent Army Doctrine Publication (ADP) 6-0 Mission Command, dated 31 July 2019, references Klein and naturalistic decision making.

Major John F. Schmitt, United States Marine Corps Reserve (USMCR) was the primary contributor to Fleet Marine Force Manual 1 Warfighting (now titled Marine Corps Doctrinal Publication (MCDP) 1), which references naturalistic decision making and Klein. With minimal change since its original publication in 1989, MCDP-1 is the Marine Corps' seminal doctrinal publication with the greatest influence on Marine thinking. As it has for the past 30 years, it defines how all Marines today think about maneuver warfare, the warfighting doctrine of the Marine Corps. In 1999 Schmitt proposed the Recognitional Planning Model (RPM) as the Marine Corps' planning model in a paper co-authored by Klein.[11] Additionally, Schmitt was one of the main contributors to what is now Marine Corps Doctrinal Publication 5-10, the Marine Corps Planning Process. Schmitt was, and the Marine Corps still is, heavily influenced by the principles of naturalistic decision making.

Gerd Gigerenzer is another well-known and vocal critic of both Kahneman and Klein. He has written many articles and papers about his disagreements with heuristics and biases research. Gigerenzer's is the director of a team of researchers at the Center for Adaptive Behavior and Cognition at the Max Planck Institute for Human Development in Berlin. Together they have developed an alternative to heuristics and biases research they call smart heuristics. It uses heuristics to explain the minds ability to make decisions, but focuses on the purposeful ignorance of information to make decisions in complex environments and does not view the idea of

[11] John Schmitt and Gary A. Klein, "How We Plan," *Marine Corps Gazette* 83, no. 10 (October 1999): 18-25.

irrationality as being as important as heuristics and biases does.[12] His two main criticisms are: the definitions used in current heuristics research are not precise enough to stand up to scrutiny; and because this lack of precision is the basis of heuristics and biases research, they divert intellectual focus and resources from conducting detailed research on cognitive biases necessary to advance a different theory of the value of heuristics.[13]

In 1996 Klein supports a critique of heuristics and biases research by Gigerenzer. Klein cites Gigerenzer's research that illustrates that predictable biases become less frequent when the decision maker is made explicitly aware of inputs available to aid in making the decision rather than simply being given a research question and asked for a decision without any explanation.[14] This is another example of a critique of the research methodology of heuristics and biases that to its critics highlights the limitations.

In 2009 Kahneman and Klein co-authored an article titled *Conditions for Intuitive Expertise: A Failure to Disagree* which is an excellent starting point to begin to address opposing and supporting thoughts to both research areas. It may seem that naturalistic decision making and heuristics and biases are in opposition, but in fact it is not as simple as one or the other, or which one is better. The result of their relationship is not absolute. There are similarities in the two schools of decision making research as noted in the article, but the article highlights an important distinction in how each defines the conditions in which intuitive judgment can be considered trustworthy.

The development of behavioral economics, the work done in 2017 by Dr. Richard Thaler, considered to be a founder of the discipline, and the 2011 publishing of Kahneman's book

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[12] John Brockman, "Smart Heuristics," In *Thinking: The New Science of Decision-Making, Problem Solving, and Prediction*, ed. John Brockman (New York: Harper Perennial, 2013), 40.

[13] Gerd Gigerenzer, "How to Make Cognitive Illusions Disappear: Beyond Heuristics and Biases," *European Review of Social Psychology* 2, no. 1 (1991): 83-115.

[14] Gary A. Klein, "Developing Expertise in Decision Making," *Thinking and Reasoning* 3, no. 4 (1997): 337-352.

Thinking, Fast and Slow have added to the body of work on human decision making. It is necessary to analyze and incorporate these new ideas into the thought habits of senior military leaders. Both Kahneman and Thaler received the Nobel Memorial Prize in Economic Sciences for human behavior, decision making, and judgment in 2002 and 2017 respectively.

A major contribution of Kahneman and Tversky's work was identifying common descriptions and terminology for cognitive functions. Prior to this, there was no common, accepted language amongst social science researchers. Economic psychologist Robin Hogarth used the terms tacit and deliberate systems, psychologist Seymour Epstein referred to them as experiential and rational and another psychologist, Steve Sloman, called the two minds as the associative and rule-base systems. Psychologists Stanovich and West simplified the idea by using the description of System 1 and system 2.[15] Kahneman then continued the use of System 1 and 2 in *Thinking Fast and Slow* and the description has now become the accepted standard in research since the year 2000. Providing common language has made it easier for researchers to describe and compare characteristics of cognition.

Since and during the time Kahneman and Tversky started working together, there have been numerous works that have contributed greatly to the study of decision making. The decades of the 90s, and 00s saw hundreds of books related to making better decisions in the business world. Henry Mintzburg's *The Rise and Fall of Strategic Planning Reconceiving Roles for Planning, Plans, Planners* from 1994 focuses on the difference between strategic thinking and decision making strategically and conducting strategic planning. Another influential business, decision making book is Paul C. Nutt's 2002 *Why Decisions Fail: Avoiding the Blunders and Traps that Lead to Debacles*. Business focused, decision making books have reflected the thinking and research of both naturalistic decision making and heuristics and biases, reflecting the style most popular at the time. Partially because of the demand by business leaders, the depth and

[15] Keith E. Stanovic and Richard F. West, "Individual differences in reasoning: Implication for the rationality debate?" *Behavioral and Brain Sciences* 23 (2000): 658.

breadth of decision making research has expanded over the years.

Malcolm Gladwell's 2005 *Blink* and *The Checklist Manifesto*, by Atul Gawaande from 2009 have significantly influenced decision making research. Both are *New York Times* bestseller list and are credited with helping make the study of decision making more accessible and consequently more popular.

The authoritative pioneers of heuristics and biases research are Kahneman and Tversky. Their work is widely acclaimed and is considered the biggest contribution ever made to decision making research. Kahneman continues to be a leader in the field. He was awarded the 2002 Nobel Memorial Prize in Economics for his work on heuristics and biases. In 2011 he wrote *Thinking Fast and Slow*, which became a *New York Times* bestseller and is widely considered to be the most influential work on the subject, leading to a huge amount of additional research and inspiring this monograph. Tversky was a leading researcher to the field, but he was unfortunately lost to cancer in 1996. His work still has a tremendous impact on the research field.

The Undoing Project: A Friendship that Changed our Minds by Michael Lewis (author of the highly acclaimed *Moneyball*) was written in 2017 and like *Blink* and *The Checklist Manifesto*, brought new decision making ideas to a wider audience. Lewis' *The Undoing Project* is particularly influential because it chronicles the relationship between Kahneman and his long-time research partner Tversky. His treatment of the subject complements Kahneman's *Thinking Fast and Slow*.

Thinking, edited by John Brockman in 2013, contains 16 papers from academic and researches in philosophy, psychology, neuroscience, linguistics, and statistics. Each author discusses the research currently important to their field of study, which includes: Kahneman, Tetlock (co-author of *Superforecasting: The Art and Science of Predictions*), Klein, and Taleb (who wrote *The Black Swan* among others). Brockman introduces five of the included papers. This work demonstrates the wide range of disciplines conducting thinking and decision making related research.

There is a great deal of literature from the last ten years offer thoughts on decision making including: *Decisive*, by Chip and Dan Heath, and *Left Brain Right Stuff: How Leaders Make Winning Decisions*, by Phil Rosenzweig. While these books have different arguments and different audiences, what they have in common is the goal to better understand how people make decisions and the implications for making better decisions. Daniel Arielly's 2009 *Predictably Irrational: The Hidden Forces That Shape Our Decisions*, expands on the causes and impacts of irrational decision making. This research is related to that of Thaler and Sunstein.

Richard Thaler spent a year at Stanford, 1977-78 conducting research with Kahneman and Tversky. He is a recipient of the 2017 Nobel Memorial Prize in Economic Sciences and considered to the founder of behavioral economics, of which the history is outlined in his 2015 book *Misbehaving: The Making of Behavioral Economics*. Thaler is currently a professor at the University of Chicago Booth School of Business. It is important to highlight the pioneering nature of Thaler's work which and its opposition to the fundamentals of the Chicago school of economic thought which dominated economic theory for more than the latter half of the 20th century. The debate between the classic thought of economics and behavioral economics is highlighted in *Misbehaving.* In 1985 University of Chicago Graduate School of Business professors Robin Hogarth and Mel Reder held a conference and among the participants were some of the most well-known and respected people in their respective areas of expertise: Herb Simon, Amos Tversky, and Daniel Kahneman for the behavioral team: and Robert Lucas, Merton Miller, and Sherwin Rosen on the rationalist team.[16] Together with Cass Sunstein he co-authored *Nudge: Improving Decisions About Health, Wealth, and Happiness* which again challenges the notion of rational decision making applied to legal and social policy making.

Decision making is an often-studied field, but the common themes are naturalistic decision making, group versus individual decision making, decision making geared toward

[16] Richard H. Thaler, *Misbehaving: The Making of Behavioral Economics* (New York: W. W. Norton & Company, 2015), 159.

businesses and business professionals, behavioral economics, and heurists and biases. Some common variables are the research methods, the audience, and the conclusions. A goal of this monograph is to consider the wide variety of research and offer an opinion about what can be used by military decision makers to improve the quality of intuitive decisions.

Naturalistic Decision Making

According to Klein, naturalistic decision making was conceived when he and Judith Orasanu were working for the Basic Research Group at the Army Research Institute. Based on their research, in 1989 they held a conference and invited fellow researchers to share ideas. This conference would become the International Naturalistic Decision Making Conference which was held for the fourteenth time in 2019. Klein is considered to be the founder of naturalistic decision making research and is still one of the leading researchers in the field. His research and the research of his colleagues has contributed to the militaries thoughts on decision making.

Intuition is about expertise and tacit knowledge according to Klein.[17] He highlights a distinction between tacit and explicit knowledge. Explicit knowledge means knowing about things that physically exist or possessing knowledge that can be known (the car is brown). Tacit knowledge has three parts: the ability to make perceptual discriminations, pattern recognition, and the ability sense anomalies in situations.[18] Tacit knowledge is different and cannot be measured as easily, but it involves intuition or the accumulation of experience. Klein's emphasis on value of intuition, a critical component of decision making, is different than the view presented later in the heuristics and biases research section. Klein describes intuition as one of the four powers that enables one to size up a situation quickly.[19] The value of intuition and the degree with which it contributes to decision making is the key characteristic of naturalistic decision making.

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[17] Gary Klein, "Insight," In *Thinking: The New Science of Decision-Making, Problem-Solving, and Predictions*, ed. John Brockman (New York: Harper Perennial, 2013), 207.

[18] Ibid., 209.

[19] Klein, *Sources of Power*, 3.

The fundamental aspects of naturalistic decision making are: real-world application; it builds on strategies people already use to make decisions; experience contributes to reasonable courses of action; and the decision requirements are context specific, meaning that decision makers can use their experience to determine then tools needed to make the decision rather than attempting to rely on more general methods that may not be appropriate to the situation.[20] Caroline Zsambok, defines naturalistic decision making as:

> The study of NDM asks how experienced people, working as individuals or groups in dynamic, uncertain, and often fast-paced environments, identify and assess their situation, make decisions, and take actions whose consequences are meaningful to them and to the larger organization in which they operate.[21]

With respect to this definition, naturalistic decision making researchers believe they can improve the quality of decisions over traditional research methods.

Klein's research emphasizes what he considers a more positive approach. Instead of conducting research that highlights the irrational and incompetent behavior of decision makers, naturalistic decision making seeks to define the behaviors that contribute to better decisions in difficult circumstances and find explanations for why some are more effective than others. In his 1999 book, *Sources of Power*, he assesses these sources of power as tools decision makers use when solving problems. The tools he defines are intuition, mental simulation, metaphor, and storytelling which are contrasted to the more conventional sources of power of deductive logical thinking, analysis of probabilities, and statistical methods.[22] Klein believes naturalistic decision making accurately assesses the attributes of decision making in real-world scenarios that cannot be replicated with the types of experiments commonly used by psychologists.

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[20] Gary Klein, "An Overview of Naturalistic Decision Making Applications." In *Naturalistic Decision Making*, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 50.

[21] Caroline E. Zsambok, "Naturalistic Decision Making: Where Are We Now?" In *Naturalistic Decision Making*, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 5.

[22] Gary Klein, *Sources of Power,* 3.

While conducting C2 research in 1988 Klein observed that military decision makers did not appear to use the rational-choice models and analytical tools expected. One tool that came of this research and research on firefighters is the Recognition-Primed Decision (RPD) model. The RPD model recognizes that experienced decision makers are able to use intuition to make decisions more effectively. The reason is that experience leads them to formulate fewer options to base the decision and the ability to do so sequentially.[23] Klein references Simon's previously discussed idea of satisficing being the key to explaining the decision making behavior of his subjects. The second aspect critical to the success of the decisions was the ability of the subjects to use their experience to intuitively understand the situation and determine a course of action without the time delay of deliberating multiple options. Experience allowed them to come up with an acceptable solution to the problem that is consistent with the time pressures they faced.

Klein has created the naturalistic decision making field of study and garnered intellectual and research contributions from like-minded researchers that believe in the value of naturalistic decision making. Klein and fellow researchers met in 1989 and held the first Naturalistic Decision Making Conference and the fourteenth was held in June 2019. After the second conference in Dayton Ohio, Klein and his associates put together a book titled *Naturalistic Decision Making*, which is a compendium of the articles that were presented by their authors at the conference. The field of naturalistic decision making remains active and committed to studying decision making research.

Ideas that influence naturalistic decision making research were seen before 1989, but due to unfortunate circumstances, this is the first year the term was used. In 1988, Iran Air Flight 655 was shot down by a missile from the USS *Vincennes*. In 1988, during the Iran-Iraq War, the US Navy was conducting missions in the Straits of Hormuz in the Persian Gulf. The mission of the

[23] Michael Drillings and Daniel Serfaty, "NDM in Command and Control." In *Naturalistic Decision* Making, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 76.

USS *Vincennes* was to protect merchant ships which had recently come under attack by both the Iranians and Iraqis. The Iranians were known to have Silkworm missiles capable of sinking ships. The USS *Vincennes* was equipped with the Aegis Combat System capable of countering the Silkworms.

Commanded by US Navy Captain Will Rogers III, the *Vincennes* deployed to the Persian Gulf in April 1988. While conducting an escort mission of the USS *Coronado,* the crew of the USS *Vincennes* executed as they had been trained and assessed two Iranian F-4 aircraft as harassing the two ships and used the ships electronics to jam the aircraft causing them to cease the harassment. Three months later, on 3 July 1988, in a situation similar to the Iranian F-4s, the *Vincennes* shot down the civilian Airbus Iran Air Flight 655 killing all passengers on board. Klein has analyzed the information from the *Vincennes* tragedy and assesses that the error of identifying the ascending Airbus as a descending F-4 attacking the *Vincennes* is a human error in decision making that is consistent with the use of mental simulation to evaluate and rule out possible explanations.[24] Klein would use the *Vincennes* case study, apply additional research and link the use of mental simulation to the RPD model. The additional research conducted was on interfaces (airborne warning and command system (AWACS) airplanes for example) used in the military to aid decision making that shows marked improvement in the quality of decisions. In the wake of the tragedy, Klein provided a technique to measure the quality of decisions. This idea continues to influence the military.

In 1994, the US Department of Defense was estimated to have spent $25-35 million on naturalistic decision making related research. The research focus was in a wide range of areas from C2 to decision support systems across a wide range of ground and air-based military platforms. ADP 6-0 Mission Command and MCDP 1 from that time both reference naturalistic decision making and Klein. The research on decision making the shootdown of an Iranian

[24] Gary Klein, *Sources of Power,* 87.

commercial plane by the USS *Vincennes* is thoroughly incorporated in the military training of the time and has been carried into today.

The influence of the research on bounded rationality by Simon is important to note here because it helped better identify a realistic aspect of the human decision making process. Bounded rationality describes the idea that decisions are influenced by the information available and not purely rational. Naturalistic decision making researchers Michael Drillings and Daniel Serfaty studied rational choice models and their application to military C2. They assess that because there is room in the decision making process for the commander to exercise his judgment and apply experience to the decision that the military did not adopt the idea of rational choice.[25] The notion that decision makers make the most rational choice is inconsistent with military decision making. The degree to which decision making research views the rationality of the decision maker is important because it provides a lens through which to assess the research.

Naturalistic decision making researchers believe intuition, developed through experience, is critical to making decisions. Mental models research seeks to increase the reliability of decisions and the speed with which they can be made. The application of mental models seeks ways to allow less trained individuals to understand how more experienced practitioners approach making decisions. The objective is to use different mental models to increase the quality of intuition with less experience. The goal of mental model research is to reduce the decision makers desire for more information and give them tools to better manage their actions within the time constraints.

Klein developed naturalistic decision making and created a community of like-minded researchers to study how humans use intuition to make decisions in real-world situations. The most effective thing he did for the military was to make decisions more understandable by

[25] Michael Drillings and Daniel Serfaty, "NDM in Command and Control." In *Naturalistic Decision Making*, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 73.

demonstrating a way to measure their quality. This accessibility combined with the military's ideal of decisive leaders who act quickly when confronted with a problem have led naturalistic decision making to have significant influence on decision making and training.

Heuristics and Biases

In his 2017 book, *The Undoing Project*, Michael Lewis spent a fair amount of the book trying to capture the nature of the personal and professional relationship between Kahneman and Tversky. Tversky's wife Barbara, a Professor Emerita at Stanford University and Professor of Psychology and Education at Teachers College, Columbia University, described it like this, "Their relationship was more intense than a marriage." In the same terms, she described the end of the relationship by saying: "It was worse than a divorce."[26] Although unusual that the relationship of two researchers is relevant to their work, it bears consideration because their collaboration is unusual in the significance it has on the field of decision making research.

Kahneman and Tversky's working relationship started in the late 1960s when they both taught at the University of Michigan and would begin in earnest in 1969 when they both returned to Hebrew University of Jerusalem in Israel. In the beginning, Kahneman was known as a skilled psychologist with an exceptional ability to teach people how to teach because. He could effectively emphasize the parts and variations of a teaching problem. He was also known to be so sensitive to criticism that it drove him to approach his research theories from every possible angle, ultimately leading to ideas not previously considered. Tversky is described by Kahneman and everyone who knew him as the smartest person in any room. A brilliant man with a mathematical mind, he did not represent the usual ideal of a psychologist in his personality and approach to research. It is easy to overlook and undervalue the impact of the unique relationship between Kahneman and Tversky, but their approach to psychology changed the world's

[26] Michael Lewis, *The Undoing Project: A Friendship That Changed Our Minds* (New York: W. W. Norton & Company, 2017), 332.

perspective on decision making.

The Two System Model

The idea of two separate and distinct characteristics of the mind dates back thousands of years. Aristotle described the "mind and soul" and Sigmund Freud referenced two minds in his research as the "id and ego." The current accepted terminology to describe this is System 1 and System 2. The two system model provides language that helps compare and better understand intuitive thinking.

An example of System 1 and 2 is illustrated in a 2013 study conducted by Snyder, Ashitaka, Shimada, Ulrich, and Logan.[27] The study describes the results of four experiments conducted on typists, using the standard QWERTY keyboard. The participants in the study had typing skills averaging 72.2 words per minute. When presented with the layout of a blank keyboard and asked to label the individual keys on keyboard, on average the participants could only label 57 percent of the keys and of this 25 percent were labeled wrong and 20 percent were not even attempted. This error in the skilled typist's ability to identify keys on a keyboard demonstrates the two systems of cognition. The human brain allows the hands to type words quickly and correctly on a keyboard, but when asked to recall the letters of the keys, humans do so incorrectly more than half the time. The connection between the hands and the mind allow the words to be typed correctly, but there is evidence that once the skill is learned the hands are able to type without the mind's knowledge of the actual process by which it is done. When learning to type, System 2 deliberately controls the action of the hands typing, but after System 1 learns the activity, System 2 no longer regulates the typing action of System 1, freeing System 2 to focus on other tasks. Following is a description of System 1 and 2.

System 1

[27] Kristy M. Snyder, Yuki Ashitaka, Hiroyuki Shimada, Jana E. Ulrich, and Gordan D. Logan, "What skilled typists don't know about the QWERTY keyboard" Published online: 8 October 2013, Psychonomic Society, Inc. (2013): 163, https://doi.org/10.3758/s13414-013-0548-4.

Kahneman writes that System 1's fundamental characteristic of associative memory continually makes one aware of what is going on around them at any given time.[28] System 1 is considered to be the older system from an evolutionary perspective. It is described as automatic and effortless and it has the ability to do parallel processing, meaning it can perform multiple tasks at the same time. System 1 is associative, intuitive, and perceptual with the ability to make rough estimates and determine correlations between and among inputs. It is the first to receive and process information from the senses. The characteristic that distinguishes it from system 2 is that as it receives the inputs, which at times can be significant, it has the first task of making sense of them and preventing the cognitive process from becoming stuck trying to process too much information at one time. Its job is to simplify. It is important to emphasize that it is understood that System 1 is automatic, that is to say it cannot be controlled and when it is being used an individual is not aware or able to describe the processes, only the results of its operation.

System 2

System 2 is a separate system that has its own functions. One of these functions is to monitor and train System 1. From a psychological perspective, System 2 is what you think of when you think of your mind, it is what you are describing when you try to try to describe yourself. In contrast to System 1, it is thought to have evolved more recently. It is slow, deliberate, and has the ability to run multiple processes simultaneously. If System 1 is automatic, System 2 is the opposite, it requires effort, but this also means it can be controlled and directed to handle many tasks. Cognitively, System 2 is responsible for calculating, rule following, and deciding among options. Kahneman provides a useful analogy of an electrical circuit to System 2. When overloaded, an electrical system shuts off one of the circuits to prevent overload, but System 2 does not turn off focus, but it prioritizes its attention to what it considers the most important load on cognition. As more capacity becomes available System 2 is able to direct

[28] Daniel Kahneman, *Thinking, Fast and Slow*, 13.

attention to additional tasks unable to be managed by System 1.[29]

Driving a car provides another example of the relationship between System 1 and 2.[30] When a person first learns to drive a car they are focused on all aspects of driving, the wheel, the mirrors, and the pedals. They are conscious of signs, all the cars around them, and it is difficult for a new driver to do anything other than drive. Listening to the stereo or carrying on a conversation with a passenger is challenging because System 2 is fully engaged and deliberately directing the minds attention on the new skill of driving. As time progresses and the new driver gains experience driving, the actual act of driving becomes one of the things they focus on the least. System 1 takes over the routine and familiar aspects of driving, leaving system 2 free to focus on other more complex tasks.

Related Concepts

Kahneman's description of how the mind makes intuitive judgments is illustrated in the idea of System 1 and 2. While this is the overarching framework of the study of heuristics and biases there are several important ideas related to understanding judgment and decision making. Those most relevant to the study of military decision making are: "what you see is all there is" or WYSIATI, the ideas of substitution and rational behavior, and the base heuristics used in decision making research.

Kahneman describes the mind's ability to be intuitive and make a judgment with limited information in an idea he calls "what you see is all there is" or WYSIATI. He gave it a name because of the frequency it comes up in his work and describes it as "so important to an understanding of intuitive thinking".[31] The basis for WYSIATI is that System 1 does not factor

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[29] Daniel Kahneman, *Thinking, Fast and Slow*, 35.

[30] Ryan Hamilton, "The Two-System Model of Decision Making," Lecture 2, in *How to Decide: The Science of Human Decision Making*, Video, The Great Courses Library Collection (Chantilly, VA; The Teaching Company, 2016).

[31] Daniel Kahneman, *Thinking, Fast and Slow*, 86.

the quality or quantity of the information which it is presented when coming up with an intuition about something. WYSIATI is seen in many of the cognitive biases induced by heuristics, to name a few: overconfidence, framing effects, and base rate neglect. The importance of WYSIATI cannot be understated, it is constantly at work as System 1 makes sense of the information it has available and makes intuitive judgments. WYSIATI is at work when you receive a brief from someone and they skew the information to incline you to agree with their perspective. It is a natural process of the relationship between System 1 and 2. If given information, System 1 will seek to make sense of it and make a judgment, regardless of whether or not System 2 intervenes and seeks to gain more or better information that could result in a better judgment.

Substituting is not a heuristic itself, but it represents what happens when humans solve difficult problems. When the mind is presented with an opportunity to make a judgment but does not have an answer, System 1 searches for an easier problem to solve. It does this because system 2 avoids becoming engaged if System 1 can find an alternative, substitution, to the actual solution to the problem presented. This action is represented by Kahneman writes "the idea of substitution came up early in my work…, and it was the core of what became the heuristics and biases approach.

Rational Choice

The model of rational choice commonly used to describe decision making in economics and decision making theory is not consistent with the behavior of humans.[32] An important distinction between earlier intuitive decision making research is the idea that humans are always rational when choosing. Prior to the work of Simon, Thaler, Tversky, and Kahneman, the essential, base belief of the study of economics was that humans made rational choices. The idea that human decision making is not rational fundamentally changed the way researchers viewed decision making.

[32] Daniel Kahneman, *Thinking, Fast and Slow*, 411.

Herbert Simon was an influential figure in 20th century decision making research. An economist by training, he would begin to change the perspective on decision making moving away from the idea that all decisions are rational. In 1947 he published *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organizations*, which was revised four times during his life. This writing offers two significant contributions to the field of decision making. First, it has become widely influential in business decision making research with more than 30,000 Google Scholar citations. Second, it introduced the idea of bounded rationality and the term satisficing. Satisficing was the first step in describing decision making that resulted in an acceptable solution, instead of the idealistic solution that maximized the utility of the decision, which is the basis for most economic decision making. It took until the 1990s and beyond to really catch on, but Simon's idea that humans do not make rational choices when confronted with decisions is now commonly considered to be accurate by decision making researchers.

Kahneman describes his and Tversky's work on prospect theory as "the most significant work we ever did."[33] Prospect theory, informed by the two-system model, is the basis for the idea that rational decisions by humans should not be assumed. In 1979, "Prospect Theory: An Analysis of Decision under Risk" was published. Prospect theory demonstrates the idea of loss aversion and demonstrates people are less rational when odds are framed as losses.[34] The results led Thaler to decree that the expected utility hypothesis was no longer valid.[35] Expected utility was a fundamental theory of economic and the work of Kahneman and Tversky on decision making would continue to impact disciplines outside psychology.

In 1983 Kahneman and Tversky were researching to better support their idea of prospect theory. While doing this, they came across one of the fundamental theories of heuristic and biases

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[33] Daniel Kahneman, *Thinking, Fast and Slow*, 271.

[34] Daniel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision under Risk" *Econometrica* 47, No. 2 (1979), 292.

[35] Daniel Kahneman, *Thinking, Fast and Slow*, 288.

research. The paper “Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment” introduced a “problem” and the idea of the conjunction fallacy. The Linda Problem is widely recognized and established the basis for the view that humans do not always seek the most rational choice when making decisions. In the Linda Problem, study participants are given the following information about a fictitious woman named Linda:

> *Linda is 31 years old, single, outspoken and very bright. She majored in philosophy. As a student, she was deeply concerned with issue of discrimination and social justice, and also participated in anti-nuclear demonstrations.*

They were then given eight statements that represented different descriptions of Linda. The two most important to the conjunction fallacy are; Linda is a bank teller” and “Linda is a bank teller and active in the feminist movement.”

The narrative of Linda creates a picture in the mind of people participating in the study. This narrative leads them to think Linda is more than a bank teller because of the way it is presented and the story the mind sees. That she is a bank teller and something else, anything else, is less probable because being a bank teller is contained alone in the other statement. In response to the answers, Kahneman asked participants “Do you realize you violated a fundamental rule of logic?” but they repeatedly validated the conjunction fallacy demonstrating human decision making by the representativeness heuristic.[36]

In the case of the Linda Problem, System 2 stays idle and does not prevent System 1 from making a biased judgment in spite of no facts that support the judgment. Time after time and study after study, 85 percent of participants chose “Linda is a bank teller and is active in the feminist movement” over “Linda is a bank teller”, which is a

[36] Michael Lewis, *The Undoing Project*, 325.

logical mistake.[37] This result is indicative of the representative heuristic and demonstrates the probabilities people use lead to inaccurate judgments.

Heuristics and Biases Defined

System 1 and 2 govern the cognitive processes by which intuition results in judgment. With this understanding and knowledge of some of the fundamental concepts of the research, heuristics and biases will be presented. Together, System 1 and System 2, the related concepts, and heuristic and biases provide a complete understanding of the research and how it is applicable to military decision making.

Heuristics

Simply defined, a heuristic is as a mental shortcut. It is a model used in psychology to describe what when people make intuitive judgments. Common examples of heuristics are rules of thumb, stereotyping and profiling, and educated guesses. In each of these instances, a person uses what they think to be true to help make a faster decision by simplifying the situation. This simplification does not necessarily arrive at the best decision, but an acceptable one under the conditions. The human brain seeks to reduce the amount of work it has to do to understand and make decisions about what it is seeing. Most of the time this is acceptable. Cognitive load has been reduced and an acceptable outcome is achieved. This is an example of the influence of System 1 over cognitive processes. Availability, representativeness, and anchoring and adjustment were the first heuristics identified by Kahneman and Tversky and are still the most commonly used.

Availability

The availability heuristic is defined by the ease with which information is available to System 1. The greater availability of information increases the likelihood it will be used without

[37] Richard H. Thaler and Cass R. Sunstein, *Nudge: Improving Decisions About Health, Wealth, and Happiness* (London: Penguin Books, 2009), 27.

scrutiny from System 2. One may assess the likelihood of throat cancer by how easy they are able to recall people they know with throat cancer. This number changes if the question becomes broader by asking the likelihood of someone having cancer in general, not a specific type of cancer like throat cancer. In one's judgment, the likelihood of a specific type of cancer will be based on their available knowledge of people with throat cancer. That is, the more instances of throat cancer of which they are aware will increase their estimate of the likelihood and percentage of throat cancer regardless of actual knowledge of the likelihood by percentage of the whole.

Think about the last time you watched the news or read the paper several days in a row and determined that it was a slow week where there were no significant issues being highlighted by the news media. What dominated the discussion of news among groups of people? Was it the war in Afghanistan, the Arab-Israeli conflict, or world hunger? If none of these issues were being highlighted, it most likely was none of these, but it was the non-events, or whatever people were being presented by the media. Although the issues were perhaps far less important, they were what was available and likely what was being discussed. This is an example of the availability heuristic and anyone who has ever served on a general/flag officer military staff can likely see how those members of the organization participating in the planning process, charged with identifying objective information to increase the commander's understanding of the problem, could likely commit the availability heuristic based on the most dominant narrative story going around at the time.

Representativeness

The representativeness heuristic can be seen when making a judgment on the characteristics of something in comparison to things that are similar. Humans recall the first example they have in mind and this becomes representative of all similar items or situations regardless of the presented facts. It can be illustrated by considering the following questions dealing with probabilities. What is the probability that class B stocks belong to a high performing mutual fund? What is the probability that a tsunami will result from an earthquake in the desert?

What is the probability that an earthquake will topple buildings? When one considers the range of options to answer a question, but does not have detailed knowledge of the answer, it is likely they will assess probabilities and choose an answer that is representative of the information. The answer will be informed by their estimation of the relationship between the known information, such as: tsunami and desert and class B stocks and mutual fund performance. One is likely to estimate that an earthquake in the dry desert, will not cause a tsunami based on how representative the desert is of tsunamis, but if the earthquake happens off the coast of Africa in the ocean, adjacent to desert regions, it is more likely to cause a tsunami. Based on the information provided one makes an estimation of the probability without all the facts. This is a natural process of System 1 and this estimation based on how representative one factor is to the other leads to serious errors in judgment.[38]

Anchoring and Adjustment

The anchoring and adjustment heuristic can be induced when a judgment is required and a number has been presented as part of the problem. This initial number anchors the intuitive judgment and ties the adjustment to the initial anchor. It is involved when making a numerical estimate like: how tall is someone, how much snow will accumulate, or how much does something costs are examples. When presented with a question that requires making a numerical estimate of comparison between or among numbers, the estimate becomes anchored to one of the numbers presented in the problem. An easy example that demonstrates this is to say that people under-estimate the average of a list of ten numbers when that list is presented from smallest to largest; and they over-estimate the average when those same numbers are presented from largest to smallest. The answers to the same question asked in two different ways vary widely because of the anchoring heuristic.

[38] Amos Tversky and Daniel Kahneman, "Judgment under uncertainty; Heuristics and biases," In *Judgment under Uncertainty: Heuristics and biases*, ed. Daniel Kahneman, Paul Slovic, and Amos Tversky (Cambridge: Cambridge University Press, 1982), 4.

A military example of the anchoring adjustment is at work on the rifle qualification range. A common saying regarding making changes to the sights to better align them to the target is to "make bold adjustments." This advice is based on the fact that one will make conservative adjustments from the set number of how far each adjustment will cause the impact of the round to move relative to where it is currently hitting the target. Reminding shooters to "make bold adjustments" is a cue that helps get past the anchor of estimating the impact of an individual adjustment to move to an adjustment more likely to achieve the intended result of putting the round on the target more accurately.

Kahneman and Tversky's work brought into contention the academic fields of psychology and economics. In doing this, they incited new research on decision making in two fields that had previously only rarely identified that they had anything in common. The research on heuristics and biases demonstrates the processes that take place in the mind when humans form intuitive judgments. It is this research and the more recent research on heuristics and biases where military decision making researchers should look for opportunities.

Biases

Cognitive biases, or simply biases, are errors in judgment that result from heuristics. Biases are evidence for the existence of the heuristics.[39] Under specific circumstances these errors are predictable. Being able to identify when and where these errors will occur is a focus area of heuristics and biases research. There are hundreds of biases have been identified. It is not necessary to understand all of them. What is important is the relationship between the heuristic and the biases they cause. The biases are unavoidable, they are a result of System 1 trying to make sense of the information it has been presented and the cognitive shortcuts it takes to do this. System 2 fails to catch the mistake and the intuitive judgment of System 1 is executed with the

[39] Daniel Kahneman, "The Marvels and the Flaws of Intuitive Thinking: Edge Master Class 2011." In *Thinking: The New Science of Decision-Making, Problem-Solving, and Predictions*, ed. John Brockman (New York: Harper Perennial, 2013), 388.

bias resulting in a lower quality judgment.

The study of heuristics and biases is underpinned by the idea of System 1 and 2 thinking. It represents a way to describe what happens during decision making. It is not necessary to have a detailed understanding of the cognitive functions of the mind to apply heuristic. Although there is certainly a significant amount of research detailing the subject, it is sufficient to understand the basics of heuristics and their relationship to the idea of System 1 and 2 to think about how they relate to military decision making. Heuristics and biases research provides the tools relevant to military decision makers. Military problems consistently require assessing probabilities or values and using intuitive judgment in making decisions. The research done by Kahneman and his colleagues on heuristics and biases is relevant and widely referenced. An understanding of the three main heuristics, of which each has numerous associated biases, System 1 and 2, and the fundamentals of heuristics and biases research provides the background to determine their applicability to military decision makers trying to increase the quality of their intuitive judgments and make better decisions. There are techniques and actions that can be taken to improve the quality of intuitive judgements that will be explored in the next section.

Opposition and Compliments

The differences between naturalistic decision making and heuristics and biases are in the value they place on intuition relative to judgment when making a decision and the methodology by which data is collected and research is conducted. There are staunch advocates for their preferred method on both sides. In the 2009, a co-authored article by Klein and Kahneman sought to understand under what conditions an expert's intuition could be trusted.

Naturalistic decision making researchers believe the quality of intuitive judgments are better when the decision maker is more experienced. The higher the skill and experience, the more capable they are at exercising intuitive judgments that will be more accurate. Heuristics and biases researchers believe that rather than solely assessing the experience and skill of the decision

maker, the judgment must be looked at with consideration of the heuristics and biases that could affect the outcome to the decision. This belief is a fundamental difference between the two.

In spite of the difference in the value of the intuition, there are agreed similarities between the two sets of theories about how individuals make decisions. To some degree there is both overlap and disagreement in the recommendations that flow from them. While they agree that intuitive judgments can come from skill or heuristic processes, the environment in which intuition is used is important. Among other distinctions, the range of confidence with which the decision maker exercises intuitive judgment varies.

Both experts and unskilled decision makers often do not know how they made intuitive judgments. Because of this, heuristics and biases identifies that the cause of the intuition cannot be assessed based on the confidence of the decision maker, regardless of their level of skill and or experience. Senior military decision makers have years of experience making intuitive judgments, which, combined with a culture that values confident decision making, leads to overconfidence. Heuristics and biases assesses that heuristics lead to overconfidence in their ability.[40] One can always assess the judgment was of high quality if not given information to the contrary. This lack of contrary evidence is especially apparent as military decision makers become more senior and supposedly skilled at decision making and the application of expert intuition.

An understanding of the environment is necessary to assess the value of the intuitive judgment. The ability to assess the quality of a judgment relative to the environment is greater when there is a clear and verifiable connection between what is happening in the environment, the decision makers intuitive judgment, and the outcomes. Naturalistic decision making consistently uses firefighting and the practice of medicine to illustrate that intuitive judgments are highly accurate. Heuristics and biases agrees, but contends that these environments meet the conditions of "high validity" or outcomes can more accurately predicted than when "validity" of the

[40] Daniel Kahneman and Gary Klein. "Conditions for Intuitive Expertise: A Failure to Disagree" *American Psychologist* 64, No. 6 (2009), 524.

environment decreases, such as in environments that are unpredictable.[41]

The environment where strategic military officers make decision is a critical consideration. Field grade military officers are required to make their most important decisions on the modern battlefield in environments where the consequences of their decisions are not always immediately available or may never be fully seen and uncertainty is at its highest. In this environment, predicting the accuracy of intuitive judgment is challenging and cannot be simply made based on the skill and experience of the decision maker.

While Kahneman and Klein agree on many things they recognize a fundamental difference between naturalistic decision making and heuristics and biases is that heuristics and biases researchers are more interested in errors while naturalistic decision making researchers focus on the positive aspects of performance. 'Failing to disagree' as the title states, neither do Klein and Kahneman actually agree that the other idea is the best. In spite of their note being a clear agreement on the best research method to apply to improving intuitive judgement, it is clear that using these two different approaches to understanding intuitive judgments continues to yield more insights into decision making.

Opposing Thoughts to Naturalistic Decision Making

Klein studies domains termed by psychologist Robin Hogarth as "kind" learning environments.[42] These environments have patterns that repeat and feedback is immediate and usually accurate. In domains where patterns are not clearly repetitive, intuitive decisions do not contribute to learning because the feedback is less effective. Hogarth uses the term "wicked' to describe this domain where rules are unclear or incomplete. Using these definitions, it is fair to describe the environment where senior military leaders are required to make decisions as not kind. The conclusion from this is that the applicability of naturalistic decision making research

[41] Kahneman and Gary Klein, "Conditions for Intuitive Expertise," 525.

[42] David Epstein. *Range: Why Generalists Triumph in a Specialized World* (New York: Riverhead Books, 2019), 18.

decreases as the environment extends beyond the familiar and routine.

Experience does not equal improved judgment. It may improve confidence in the decision, but it does not increase the quality of the decision. This demonstrates that the degree of complexity of the domain in which the decision is made is proportionate to the degree of accuracy intuition will provide an acceptable outcome based on the decision made. Kahneman identifies this fact in *Conditions for Intuitive Expertise: A Failure to Disagree*. Kahneman brings up another example of the relevance of domain in a 2019 interview with Shane Parrish where he further highlights the impact of the domain in which the intuition is formed.[43]

The domains where field grade officers are required to make decisions are not routine and their intuition alone will not consistently provide the best result of decisions. Considering technology and its impact on strategy. As an example, since nuclear weapons were first used during World War II, non-military expert in a given field (artificial intelligence, robotics, hypersonic missiles, additive manufacturing, etc.…) has greater experience in a given area than the military leader charged with the decision. In these most likely environments, the intuitive judgment of the military leader will be unreliable.

In the same interview Kahneman notes a powerful idea that he also spends a chapter discussing in *Thinking Fast and Slow*, and that is the idea that intuitive judgment does not recognize regression to the mean.[44] This is an important opposing thought to naturalistic decision making because it supposes that statistics are not factored into intuitive judgments because the story or picture that our mind "sees" when assessing the factors relevant to a decision is more powerful than the fact of the statistical likelihood. This reinforces the idea that, if the decision maker is not familiar with the factors involved in making the intuitive judgment, the experience

[43] Shane Parrish, "*Daniel Kahneman: Putting Your Intuitions on Ice*," 12 October 2019, in The Knowledge Project Episode #68, Farnam Street, podcast audio, accessed 5 November 2019, https://fs.blog/daniel-kahneman/.

[44] Parrish, "*Daniel Kahneman: Putting Your Intuitions on Ice*," Podcast audio.

of the decision maker will not contribute to the quality of the judgment.

A 1994 study identified a critical consideration when assessing the value of a military commander's intuition as it relates to making decisions. The study noted that the expertise that contributed to intuition was difficult to capture when applying to military C2 because the environment is characterized by complexity, uncertainty, and high tempo where there can be more than one answer.[45] In this context, it highlights the reduced applicability of naturalistic decision making to military decision making.

William C. Howell, an attendee at the 1994 NDM Conference, noted that naturalistic decision making's "unique characteristics are not yet defined very well" and that the theoretical foundation of naturalistic decision making lacked "links to the existing theory and research in judgment/decision making, problem solving, simulation, and various other domains that bear on human cognition."[46] Although this is from one observer, it is indicative of the lack of research rigor naturalistic decision making had at the time. More concerning for the military is, as demonstrated with the example of the USS *Vincennes*, the influence naturalistic decision making had on training and the money used to fund research was disproportionate to its value. To use the language of heuristics and biases, because naturalistic decision making was available, it is what was used and its influence is still seen today.

Considering the *Vincennes* tragedy and the subsequent research used to demonstrate improved decision making it is clear that the domain in which the quality of the decision was improved is not complex. It is systems and data that an operator can interpret in limited ways and as long as it is in the right place, accurate, and used correctly it will lead to better decision. This is

[45] Daniel Serfaty, Jean MacMillan, Elliot E. Entin, Eileen B Entin, "The Decision-Making Expertise of Battle Commanders," In *Naturalistic Decision Making*, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 234.

[46] William C. Howell, "Progress, Prospects, and Problems in NDM: A Global View." In *Naturalistic Decision Making*, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 45.

not the environment in which strategic leaders make decisions. The applicability of naturalistic decision making is proportionate to the environment in which decisions are required.

Opposing Thoughts to Heuristics and Biases Decision Making

In 1997, studies showed experienced decision makers in real-world situations did not demonstrate the types of mental biases found under heuristics and biases lab conditions.[47] A reason often cited by naturalistic decision making researchers is that the heuristics and biases experiments are devised in such a way as to induce the bias and demonstrate worse performance as a result.[48] They find that this is not replicated in the real-world conditions on which the naturalistic decision making research is based. There is a distinction in the methods and outcomes of experimentation with naturalistic decision making being generally representative of natural conditions (real-world) where people make decisions and heuristics and biases research done under the more traditional (laboratory) science research methods.

Implications for Strategic Decision Making

The study of intuitive judgment, expertise, heuristics and biases, and decision making is filled with passionate people in pursuit of a better understanding of how to improve the quality of decisions. But who is correct? The answer is not binary and at this point there is not enough information to definitively choose. In an interview conducted during the research for this monograph, Kahneman made several points that illustrate the where the field of study is and how much farther it can go. After almost 60 years of research and the Nobel Memorial Prize in Economics for research on the subject, Kahneman says he is not any better at avoiding cognitive biases from affecting his intuitive judgments.[49] Research may never reveal ways to prevent biases

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[47] Gary Klein, "An Overview of Naturalistic Decision Making Applications." In *Naturalistic Decision Making*, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 51.

[48] Klein, *Sources of Power*, 273.

[49] Parrish, "*Daniel Kahneman: Putting Your Intuitions on Ice*," Podcast audio.

from negatively impacting intuitive judgments or lead to individual intuitive judgment being free of cognitive errors. It may not be possible. The goal at this point is to identify those techniques and activities identified in naturalistic decision making, heuristics and biases, and more recent research that can be used, or studied further, to improve the quality of decisions. Following are ten recommendations that can be incorporated into decision making processes now or have potential to improve the quality of decisions and warrant further study.

1. Make the Organization Responsible.

Kahneman believes that organizational processes help eliminate the focus on individual intuitive decision making and increase the quality of the decision. Because organizations can define a process and ensure decisions are scrutinized, they end up being better. The effects of System 1 on the mind of an individual can be mitigated by putting a decision through a process that is not solely reliant on one individual who may impose unintended biases.

Military strategic leaders will immediately recognize the value of the organizational decision making processes of Marine Corps Planning Process (MCPP) and the Military Decision Making Process (MDMP), used by the US Marine Corps and Army respectively. Incorporating activities that highlight bias inside of the defined processes and looking for ways to modify the process to the task will increase the quality of decisions. The process of making the decision does not prevent negative effects of intuitive judgment by itself. In some ways it can institutionalize them by incorporating opportunities for cognitive errors in to the process used by the entire organization. For example, when assessing numerical outcomes relevant to a decision, avoid introducing numbers that could lead to anchoring and when using numbers ensure the process used to come up with the base number is objective and known to those who will the number to help develop intuitive judgments. To increase the quality of decisions, knowledge of System 1 and 2 processes and heuristics and biases must be deliberately considered and applied to the decision making activities, thoughts, and processes of the organization.

2. Highlight Inconsistent Thinking.

Making a decision-maker aware of the inconsistencies in their thinking is hard, but it will help them develop insight and improve the quality of intuitive judgments. System 1 is not easily trained, but if made to realize a different approach to one problem over another requiring similar tools, intuition can be made more consistent. Klein provides an illustrative example about a US Navy pilot transitioning to flying a new aircraft.[50] After fifteen successful years landing a plane on a carrier, the US Navy gets a new aircraft and the pilot has to land the new aircraft on the carrier in the same conditions. After six poor attempts to land the new aircraft on a carrier it is brought to his attention that in the previous aircraft his sitting position relative to the landing was 2 ½ feet to the right. Highlighting this inconsistency in the pilots thinking immediately corrected the problems he was having with landing the new aircraft.

This principle can be applied in training scenarios where more experienced decision makers evaluate decision making techniques of the less experienced. Creating scenarios that highlight inconsistencies in thinking and provides feedback during the decision making process could lead in increased quality of judgments.

3. Debias Thought Processes.

Attempting to eliminate bias through a process commonly referred to as debiasing is an often cited technique to avoid the errors caused by heuristics and biases. However, most research fails to identify tangible and scientifically rigorous techniques used to debias. This aligns with the Gigerenzer criticism where he notes that consistent definitions for biases have not been established and consequently, they have not been subjected to the rigorous scrutiny that would make them useful in the study of heuristics and biases.

Bazerman notes that "(o)nce you are able to spot these biases, you will be able to improve the quality of your decisions."[51] In *Judgment in Managerial Decision Making* he

[50] Klein, "Insight." In *Thinking,* 211.

[51] Bazerman, *Judgment in Managerial Decision Making,* 14.

identifies 13 “common” biases and describes them as a variety of systematic and predictable mistakes. He identifies debiasing judgment as a strategy for improving decision making, but notes that it is challenging because it requires changing behavior and a conscious effort and defined techniques.

A 2015 White Paper published by the US Army Mission Command Center of Excellence noted “it seems that the field has achieved much more progress towards cataloguing and describing an ever-growing list of cognitive biases than it has towards developing and identifying practices to prevent or remedy them.”[52] This area is immature and additional research is needed. As previously noted, Kahneman is not hopeful that biases can be avoided by individuals, but additional research may yield different results.

Another example of a possible way to debias thinking that will be familiar to military professionals is to study history and decisions. Through an understanding of how people made decisions in the past, one can apply the lessons to their own decisions. US Marine General and former Secretary of Defense James Mattis has numerous quotes about the value of studying history. While increasing knowledge of history is generally viewed as contributing to a greater understanding of warfare, it may also be viewed as a way to prevent biased thinking.

The opposite of effect of history is to be cautioned. Knowledge of history may image historical events onto a problem being faced because of the familiarity with the historical event (representativeness). Military decision makers seeking to improve the quality of their decision should study history, but avoid the temptation to blindly (or inadvertently) apply it to the future. You have to understand the human dynamic, but also consider the unique aspects of the environment as it is presented. This ties to the next recommendation.

4. Be Smarter.

[52] Joseph Rodman, *Cognitive Biases and Decision Making: A Literature Review and Discussion of Implication for the US Army* (Fort Leavenworth, KS: Mission Command - Capabilities Development and Integration Directorate (CDID), 2015), 20.

This may seem like a pretentious recommendation, but being smarter means continuing to educate yourself in a wide range of areas. Reading frequently is an often cited example of how to increase knowledge and research shows that problems solving and being versed in a wide range of manual skills can contribute to knowledge. Kahneman believes that smarter people are more likely to make higher quality decisions. Because they have more intellectual resources to draw from when confronted with a problem the results of the decision are better. This aligns to Klein's belief that the quality of intuitive judgment is better when the decision maker is more experienced (smarter). Ironically because they are smarter, they are also more likely to be able to justify why their judgment is correct and in doing so fall prey to cognitive bias without realizing it.

Kahneman notes that someone who seeks to "make better judgments" is unlikely to do so.[53] Because System 1 cannot be manipulated to make better intuitive judgments, increased knowledge is a way to ensure that the resources on which it draws will be more likely to have the information needed to make a better decision. Regardless of the methods an individual uses to become smarter, refer back to the first recommendation of this section and remember that the processes of the organization are more likely to produce a better judgment than the individual.

5. Improve Assessments.

Assessments have become a significant activity of military planning during recent years. Simply conducting assessments is not enough. To make the assessments more effective, the results need to be measured against the environment as it is, not as one wants it to be. This is where the problem with assessments arises, biases enter the process when influenced by System 1's intuitive judgment of the environment. Opportunities for bias are embedded in the development of the assessment criteria, the assessment itself, and how the assessment influences decisions after it has been made.

[53] Parrish, "*Daniel Kahneman: Putting Your Intuitions on Ice*," Podcast audio.

Applying specific criteria considered to prevent bias, similar to the decision making process of organizations would improve the quality of judgments. The process of what to assess and how the assessment is conducted must be deliberately developed to minimize the risk of individual and organizational bias. Objectivity is the key and each step the assessment process should highlight and consider where biased thinking could have influenced the outcome. How biases might be applied to those using the results of the assessment should also be highlighted.

In an 8 January 2007 column in *The New York Times* titled "Quagmire of the Vanities" Paul Krugman provides an example of Kahneman's work that illustrates the influence of bias on assessments. Kahneman stated "the administration's unwillingness to face reality in Iraq reflects a basic human aversion to cutting one's losses-the same instinct that makes gamblers stay at the table, hoping to break even."[54] Recreating an objective decision making process of the assessment that the "surge" in Iraq could appreciably change the outcome would highlight numerous examples of rational choice theory, heuristics, and systemic flaws in thought processes.

6. Incorporate Algorithmic Thinking.

Meehl's book *Clinical versus statistical prediction: A theoretical analysis and a review of the evidence* demonstrated 11 of 14 times that statistical algorithms beat human judgment in clinical studies. In the 50 years since there have been more than two-hundred studies conducted and the percentage of times where the algorithm beat human judgment has not changed; 60 percent of the studies show higher accuracy for algorithms and 40 percent are even between the algorithm and human, but the draw could be considered a win for the algorithm because it generally makes the decision with less cost relative to the cognitive demands placed on the human exercising their judgment.[55]

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[54] John Brockman, "Edge Master Class 2007 Daniel Kahneman: A Short Course on Thinking About Thinking," Edge, 19 July 2007, accessed 8 January 2020, https://www.edge.org/event/edge-master-class-2007-daniel-kahneman-a-short-course-in-thinking-about-thinking.

[55] Kahneman, *Thinking, Fast and Slow*, 222.

Military decision makers have an aversion to "automating" decision because the ultimate cost of the many decisions is the loss of human life. The term algorithm generally refers to processes performed by a computer, but a computer is not necessary for an algorithm. Humans can solve problems with their minds using algorithms. The most important part of the definition of algorithm with respect to human decision making is that it is a basic set of rules for problem solving. Considering risk and the reliability of intuitive decision making, conducting research on how to incorporate the use of algorithms into military decision could yield improved results or at the least free up time and cognitive resources for other more important tasks. In a recent interview from 2019, Kahneman identifies several challenges to using algorithms, most notably the social costs, or to put it another way, giving up the decision to a formula.[56] This is not about blind adherence to a formula like X number of bombs will lead to desired result Y, but using critical thought to identify sets of rules that can be used when they offer a more effective outcome. While there are challenges, the lesson for military decision makers is to simplify and make certain aspects of a decision replicable and consider using automated processes in a deliberate way that speeds decisions.

7. Conduct a Premortem.

Premortem is a process developed by Klein to assess the quality of a decision before it is made.[57] It is a relatively simple idea that helps highlight errors in potential decisions. The idea behind the premortem is to identify things that could go wrong inside of or after a decision is made. Doing this prior to the decision allows time for the feedback to be analyzed and incorporated into the final decision. A common method to conduct a pre-mortem is to start with the assumption that the worst-case scenario outcome of the problem being studied has happened. Each person participating generates a list of negative outcomes they can see for the decision.

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[56] Parrish, "*Daniel Kahneman: Putting Your Intuitions on Ice*." Podcast audio.

[57] Gary Klein, "Performing a Project Premortem," *Harvard Business Review*, September 2007, https://hbr.org/2007/09/performing-a-project-premortem.

From these lists, the team or decision maker identifies those relevant to the potential decision and figures out how to apply them to the decision to come up with a better outcome. As a process, this could easily be incorporated into military decision making.

8. Increase Mental Models.

In addition to putting decisions through an organizational process, decision makers need to have their own internal mental process for approaching complex problems. Mental models add another tool to help describe how to improve the quality of decisions humans make. They are necessary for the full understanding of how strategic leaders exercise judgment. Having a range of mental models from which to choose and appropriately applying alternative models may improve decision making.

Charlie Munger is credited with the idea of mental models. He first presented the idea in a speech he gave at University of Southern California Business School in 1994 that has become widely known as the "Worldly Wisdom" speech. Munger is a famed investor and vice chair of the board of directors for the company Berkshire Hathaway, whose CEO is billionaire Warren Buffet. In the speech Munger said, "You've got to have models in your head. And you've got to array your experience—both vicarious and direct—on this latticework of models. You may have noticed students who just try to remember and pound back what is remembered. Well, they fail in school and in life. You've got to hang experience on a latticework of models in your head."[58]

9. Avoid Comparing

Arielly's book *Predictably Irrational* demonstrates the phenomenon that, given the opportunity to compare one option to another, the first attractive option seen will establish your preferences. Again, using the US Marine Corps and Army planning processes of MCPP/MDMP as an example, there is a step called course of action comparison and decision, which leads to a

[58] Charlie Munger, "A Lesson on Elementary, Worldly Wisdom As It Relates To Investment Management & Business" (Speech, University of Southern California Business School, 1994).

comparison of potential choices. If the appearance of a more favorable choice is based on intuition, does giving the opportunity to choose result in a less than optimal outcome?

Jeff Grossman and Ed Salas conducted research that demonstrated the formal planning models used by the military resulted in counterproductive results. The example they use is the requirement in MDMP/MCPP to develop multiple courses of action (COAs) when confronted with time constraints and the fact that the decision maker is already aware of an acceptable choice to the given problem.[59] The goal of comparison is to offer different opportunities to increase the likelihood that the problem has been thoroughly studied and this is valuable. There are however risks in the manner in which the options are presented and the necessity to develop different options. Using available data and identifying thought process behind the range of options at each step of the decision making process could produce a better outcome than simply presenting choices that are susceptible to cognitive bias based on the perceived suitability of a choice.

10. Mitigate the Halo Effect

The halo effect leads to a reversal in identifying causal relationships. That is to say, an outcome can be seen as beneficial because what can be perceived at the time is positive rather than the reality that what is happening appears beneficial, but the ultimate outcome could still negative. To put it another way, if in a crisis, decision making is centralized, the appearance is the decision maker is authoritarian, rather than the reality, which is that the crisis caused the need for centralization. Rosenzweig's *The Halo Effect*, discusses the demand for illusory certainty.[60] He finds that stories of success and failure among business writing too often places undue emphasis on the characteristics of individual leaders making decisions in a moment of crisis and because of this, the works are not very useful.

There is a similar emphasis on the individual decision maker in the military. The cultural

[59] Caroline Zsambok, "Introduction," In *Naturalistic Decision Making*, ed. Gary Klein and Caroline E. Zsambok (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1997), 4.

[60] Kahneman, *Thinking, Fast and Slow*, 206.

reliance on confidence of the leader and the hierarchy of the military are significant contributors to the halo effect. Being confident is important to trust, but military decision makers must not confuse confidence for accuracy. Decisions need to be judged objectively based on their quality and the halo effect should be consciously avoided.

Conclusion

Incorporating the techniques recommended in this monograph into the habits of thought of senior military leaders can improve intuitive judgment in the novel environments where they the most challenging decisions are made. Additionally, military doctrine and education can be updated to reflect current methods that will improve decision making by introducing concepts earlier in the military leader's career.

Naturalistic decision making can be used on what can be referred to as "now" problems. It can be used in settings that are complex and characterized by repeatable situations where feedback is reliable and generally immediate. This is great for training someone how to land a plane under varying conditions or teaching many people to respond in a similar way to a similar situation. Unfortunately, it is only one mental model that does not achieve the full range of thought necessary to improve decision making. Incorporating insights from heuristics and biases research adds the cognitive tools necessary to improve intuitive judgments in the most common situations faced by senior military leaders; novel problems with variables that are unknown or can only be poorly estimated.

Naturalistic decision making has clear value, but the idea that intuition and pattern recognition can speed decisions seems most valuable when applied to problems that can be recognized. These are not the problems faced by senior military officers. Few are simple with recognizable patterns. To improve intuitive judgment and decision quality, current research on heuristics and biases and intuitive judgment must be incorporated into the training of senior military officers.

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